A. OVERVIEW

Sea Launch is a new, innovative system for launching commercial satellites from a platform at sea. It is being developed in response to high market demand for a more dependable and affordable commercial satellite launching service. The Sea Launch program is an international joint venture owned by Boeing Commercial Space Company, RSC Energia, KB Yuzhnoye, and Kværner Maritime a.s.

The system will utilize the proven Block DM-SL and Zenit rocket, manufactured by RSC Energia of Russia and KB Yuzhnoye of the Ukraine, to launch its satellite payloads (spacecraft) from equatorial locations in the Pacific Ocean. The rocket will be launched using two vessels: the assembly and command ship (ACS) and the launch platform (LP), which are provided by Kværner Maritime a.s of Norway. In port, the ACS will serve as the rocket assembly and integration facility and as the mission control center at the launch location. The LP is a converted, semi-submersible drilling platform. It will transport the integrated launch vehicle (ILV) to the launch location and will be used as a steady launch pad for the conduct of launch operations.

The Home Port is proposed as the staging area for Sea Launch operations. It will provide the facilities and personnel necessary to prepare for launch missions. The principal operations to be conducted in the Home Port are spacecraft processing, encapsulation and integration of the spacecraft payload, assembly and checkout of the rocket, vessel maintenance and resupply, and mission operations planning.

The proposed Home Port location for Sea Launch is in Long Beach, California, USA. Sea Launch will lease a portion of the former Long Beach Naval Station from the Port of Long Beach. The 17-acre facility is located on a narrow strip of land, known as the "Navy Mole." This location offers advantages from the perspective of security as well as offering a controlled access location for the conduct of spacecraft fueling operations. From a marine perspective, this location is adjacent to the harbor entrance, offering ready access to the deep water channel, as well as possessing a large turning basin for maneuvering the vessels. Refer to Figure A-1.

Figure A-1. Home Port Location and Vicinity

The integrated rocket and spacecraft to be launched by Sea Launch will be processed in the Home Port according to the following generalized scenario. The processing flow diagram is shown in Figure A-2.

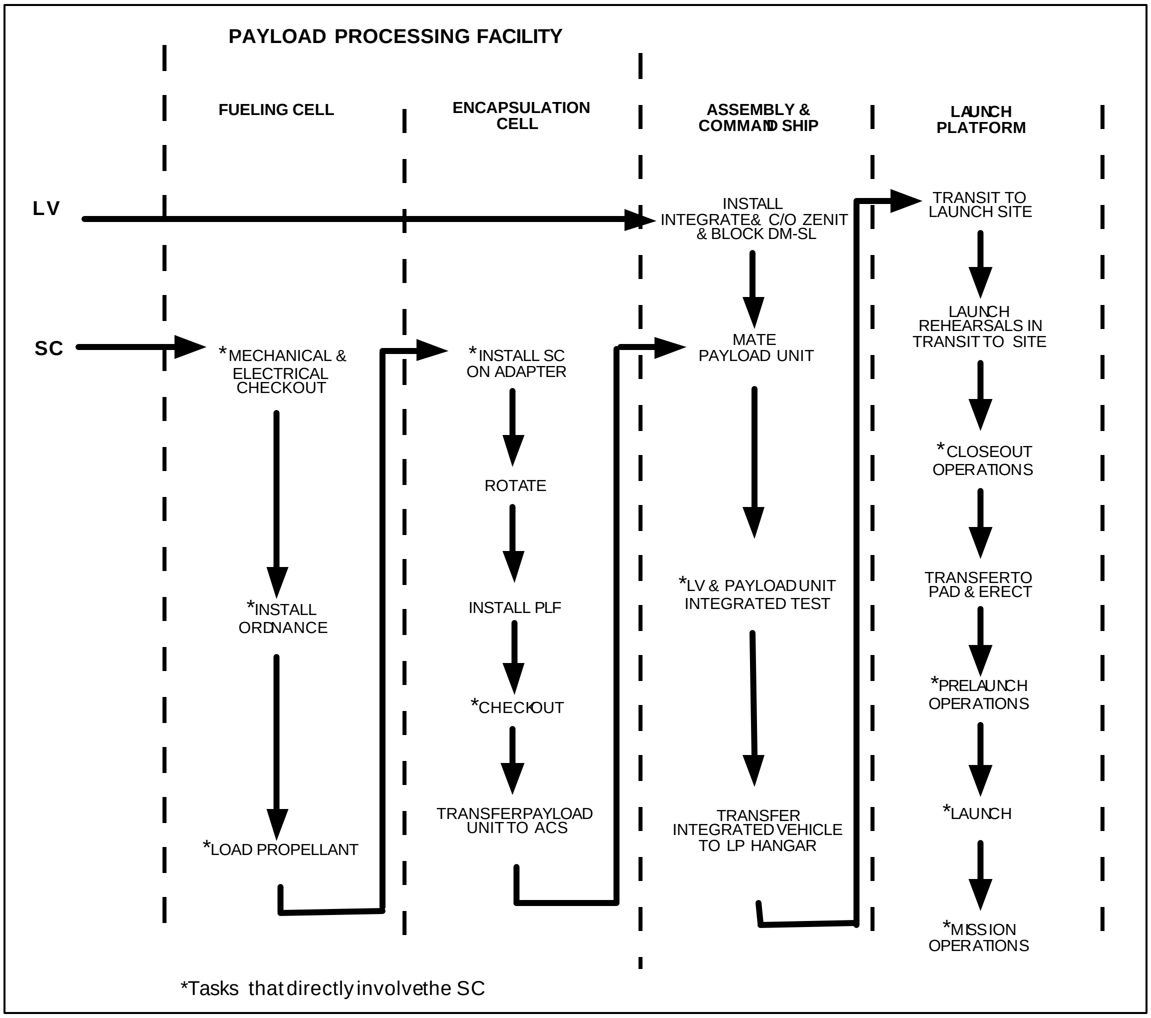

Figure A-2. Spacecraft Processing Flow

1. The spacecraft and its ground support equipment (GSE) will be delivered to the payload processing facility (PPF) by the customer (spacecraft manufacturer). The spacecraft will then be moved to its processing cell and the GSE is set up in the adjacent control room. Processing of the spacecraft will be the final phase of the assembly sequence. Processing will consist of electrical, mechanical and pneumatic functional checks, ordnance installation, and propellant loading.

2. After propellant loading operations are complete, functional tests will be run, the spacecraft will be installed on its adapter, rotated into the horizontal position, encapsulated in the fairing (which has been stored in an on-site warehouse), and tested as required. When encapsulation is complete, the encapsulated payload is considered ready for transfer to the ACS.

3. Individual, inert rocket stages, which are delivered via commercial ships, will be stored at the Home Port. Small solid rocket motors (SRMs), which are used to separate the rocket stages in flight, will be stored separately until they are loaded on the ACS with the rocket stages. Parallel to spacecraft processing, the three inert stages of the rocket will be transferred from the warehouse to the ACS where they will be processed and mated together. During the processing, the upper stage (Block DM-SL) will be partially fueled prior to mating to the second stage. Once the rocket processing, assembly and checkout have been completed on the ACS, the encapsulated payload will be transferred to the ACS for integration with the rocket.

4. On the ACS, the encapsulated payload will be mated to the rocket and the interfaces checked out and verified. When the launch vehicle checks are complete, the ACS and LP will be positioned end to end and the integrated rocket will be transferred from the ACS to the LP. Prior to leaving the Home Port, rocket fuel components and compressed gasses will be delivered and transferred onto the LP. (Note: Fueling of the rocket occurs at the launch location just prior to launch.)
5. Both vessels will depart the Home Port at the same time for the equatorial launch region and conduct of launch operations.
6. After launch, the vessels will return to the Home Port. In preparation for the next user, the spacecraft GSE will be removed from the processing facilities, ACS, and LP.

The Home Port facilities will consist of an office building, a payload processing facility, warehouse buildings, and the pier. Each of these areas is described briefly below, and in more detail in Section A.4.

1. The office building is a two-story structure of approximately 2,230 m^2 which currently exists on the location. It contains offices, conference rooms, and a marketing, training, and break area. This will serve as the Home Port management and engineering area in addition to customer offices.
2. The PPF will be a new building constructed approximately 94.5 m east of the existing buildings in the Home Port complex. The building will be approximately 3,000 m^2 with a high bay height of 19.8 m for the encapsulation cell. This facility will be used for spacecraft processing and short-term (less than 30 days) storage of spacecraft propellants. This facility will consist of two processing cells, an encapsulation cell, control rooms, change rooms, fuel cart storage areas, and a central air lock. All spacecraft processing areas will be constructed to Federal Standard 209 Class 100,000 cleanliness standards.
3. The warehouse facilities consist of existing buildings which are located near the office complex, with a total area of approximately 9,290 m^2. The large warehouse building (building 4, Figure A.4-1) will be used for storing inert rocket stages, fairings, and adapters. The remainder of the buildings will be used for storage of spares and consumables necessary for Home Port operations, spacecraft customer spares, and shipping containers. Modifications (e.g., installing doors and shelving) and cosmetic maintenance will be required.
4. The pier is an existing structure adjacent to the other facilities. It is a concrete structure supported by wooden pilings and is capable of supporting any loads which can be transported over highways. It is approximately 335 m by 18.3 m and is accessible from both sides for moorage of the vessels. Water depth at the pier is 10.7 m to 11.6 m, which is capable of supporting SLLP vessels. The pier is equipped with facilities for electrical power, water, sewage, and moorage fittings. Minor modifications to the waterfront adjacent to the pier will be required to provide a ramp landing capable of roll-on/roll-off loading of inert rocket stages and encapsulated payloads to the ACS.

A.1 LAUNCH VEHICLE DESCRIPTION

A.1.1 Vehicle History

The Zenit-3SL is a liquid propellant, launch vehicle system capable of transporting spacecraft to a variety of orbits. Figure A.1.1-1 shows the Zenit-3SL principal components.

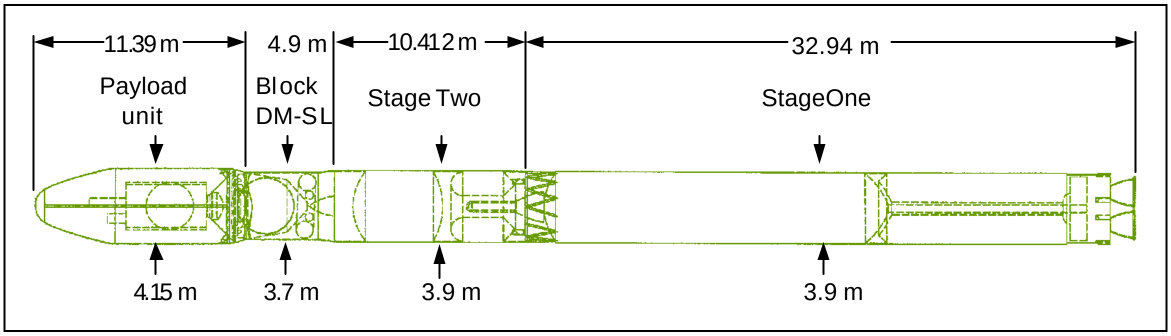

Figure A.1.1-1. Zenit-3SL Launch Vehicle

The first two stages of the Zenit-3SL are manufactured by KB Yuzhnoye in the Ukraine. The basic two-stage Zenit was developed to provide a means of quickly reconstituting military satellite constellations with design emphasis on robustness, ease of operation, and fast reaction times. The result is a highly automated launch system requiring only a small launch crew. First flown in 1985 from the Baikonur Cosmodrome in Kazakhstan, the Zenit's original use was as a launcher for electronic intelligence satellites. As of 1998, the Zenit has completed 26 missions in 31 launch attempts. Additionally, Stage 1 of the Zenit is virtually identical to the strap-on boosters used with the RSC Energia heavy lift launch vehicle. Four strap-ons are used for each Energia launch.

The Block DM-SL constitutes the upper stage of the Zenit-3SL. The Block DM is built by RSC Energia in Russia, and has had a long and successful history as the fourth stage of the Proton launch vehicle. The Block D upper stage model series has completed 196 missions in 204 launch attempts. The Block DM model used by Sea Launch has completed 98 missions in 103 launch attempts.

A.1.2   Zenit Stage 1

The Stage 1 principal structure is aluminum with integrally machined stiffeners. The RD-171 engine that powers Stage 1 burns liquid oxygen (LOX) and kerosene (RP-1). The LOX tank is positioned above the kerosene tank, and the lower dome of the LOX tank is located in the concave top of the kerosene tank. A single turbopump feeds four thrust chambers, and four differentially-gimbaled thrust nozzles provide directional control during Stage 1 powered flight. Stage 1/Stage 2 separation is accomplished through the use of forward firing solid propellant thrusters located in the aft end of the first stage.

A.1.3   Zenit Stage 2

The second stage of the Zenit also employs integrally stiffened aluminum construction. Stage 2 propellants are LOX and kerosene, and the lower kerosene tank is toroid shaped and the LOX tank is a domed cylinder. This stage is powered by a single nozzle RD-120 engine.

Three-axis control is provided by a RD-8 vernier engine which is mounted in the aft end of Stage 2. The RD-8 uses the same propellants as the RD-120, with one turbopump feeding four gimballing thrusters. The RD-8 produces 8100 kg of thrust. Stage 2/Block DM-SL separation is accomplished through the use of forward firing solid propellant thrusters located near the aft end of the second stage. Stage 1 and Stage 2 of the Zenit configuration are shown in Figure A.1.3-1.

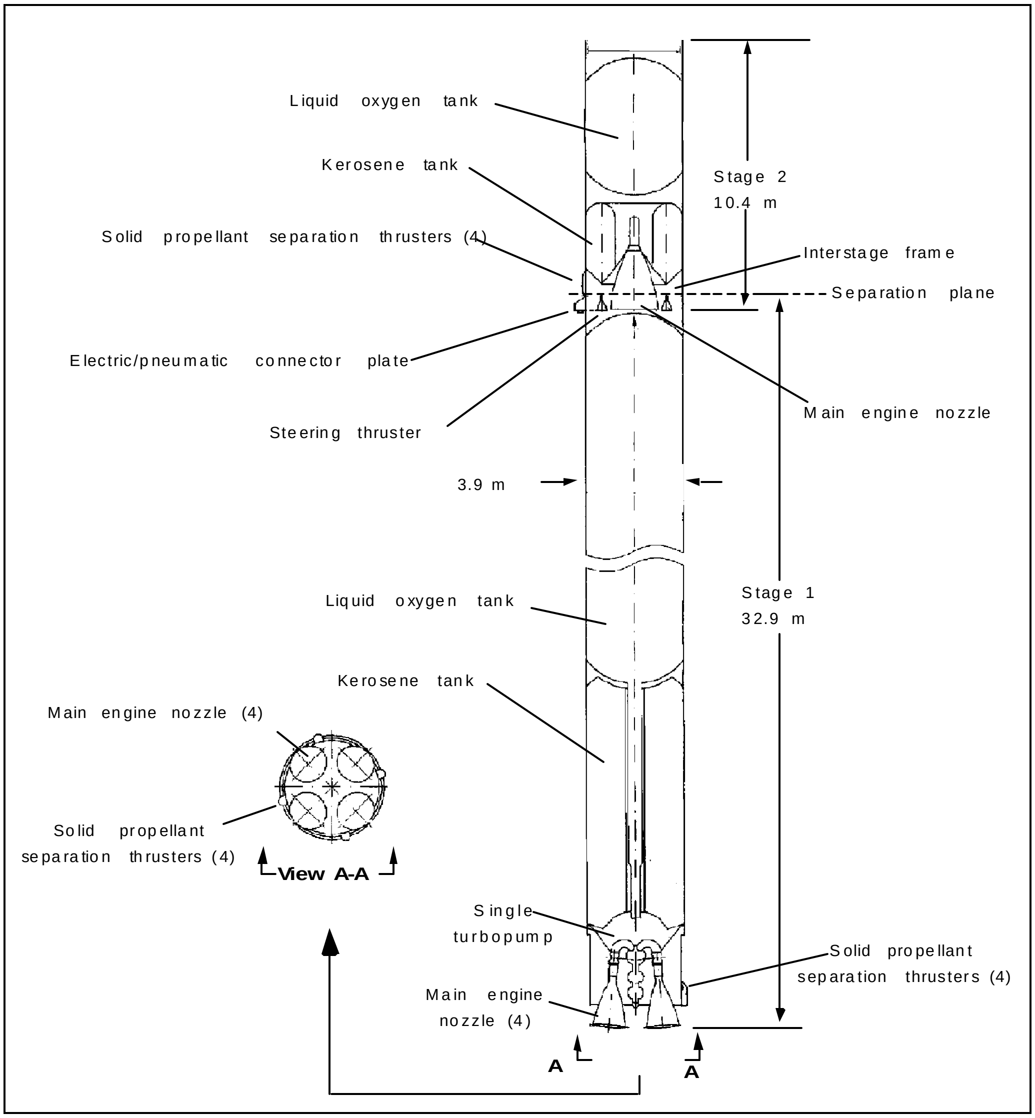

Figure A.1.3-1. Zenit Stage 1 and Stage 2 Configuration

A.1.4 Block DM-SL - Upper Stage

The Sea Launch Block DM-SL (Figure A.1.4-1) is a restartable upper stage which is capable of restarting up to seven times during a mission. The Block DM-SL is enclosed in an interstage cylinder of aluminum skin and stringer construction. All but the upper section of the interstage is jettisoned prior to the first firing of the Block DM-SL main engine. Avionics are housed in a toroidal equipment bay at the front end of the Block DM-SL.

Propulsive capability for the upper stage is provided by the 11D58M engine which operates on LOX and kerosene. The kerosene is contained in a toroidal tank which encircles the main engine turbopump. The spherical LOX tank is located above the kerosene tank. The 11D58M has a single gimballing nozzle which provides directional control during propulsive phases.